

**CONFIDENTIAL**  
 CLASSIFICATION **CONFIDENTIAL**  
 SECURITY INFORMATION  
 CENTRAL INTELLIGENCE AGENCY  
 INFORMATION FROM  
 FOREIGN DOCUMENTS OR RADIO BROADCASTS

REPORT

50X1-HUM

CD NO.

COUNTRY USSR

DATE OF  
INFORMATION 1950

SUBJECT Scientific - Electronics, vacuum, tubes, physics

DATE DIST. 2 NOV 1951

HOW  
PUBLISHED BookWHERE  
PUBLISHED Leningrad

NO. OF PAGES 6

DATE  
PUBLISHED 1950SUPPLEMENT TO  
REPORT NO.

LANGUAGE Russian

THIS DOCUMENT CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE  
 OF THE UNITED STATES WITHIN THE MEANING OF ESPIONAGE ACT 80  
 U. S. C. 31 AND 32, AS AMENDED. ITS TRANSMISSION OR THE REVELATION  
 OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PRO-  
 HIBITED BY LAW. REPRODUCTION OF THIS FORM IS PROHIBITED.

THIS IS UNEVALUATED INFORMATION

SOURCE

Primeneniye Elektronnykh Lamp v Eksperimental'noy Fizike, (

INFORMATION FROM THE BOOK, "THE USE OF ELECTRON TUBES  
IN EXPERIMENTAL PHYSICS," BY A. M. BONCH-BRUYEVICH

Excerpts from the Author's Foreword

The extensive use of electron tubes in experimental physics has given rise to a new branch of science, the radio engineering of physical laboratories. This field of experimental science is exceptionally rich in the diversity of electron tube applications. This book describes only the more typical circuits and devices, ones which have been used extensively in experimental physics. Up to this time, many of these have been described only in general terms or cited only in periodical literature. The book also includes some general information on electric processes in devices containing electron tubes.

The book was completed early in 1949 and only a few changes have been made in its since. The book was based on a course of lectures read to upper-division physics students. In content, purpose, and structure, the book differs essentially from courses on radio engineering and electron tubes published previously, as the latter were intended primarily for radio engineers. This book is intended for physics students and experimental physicists.

The bibliography of 107 entries contains only 31 Russian items. It is notable, too, that these items are generally cited wherever the discussion is theoretical, while other sources are usually cited when a relatively new specific application is under discussion. For example, in Chapter I, Paragraph 6, Section e, "Artificial Lines" (under which heading delay lines are considered), the only references given are articles by Blewett and Kallman in "Proceedings of the Institute of Radio Engineers".

- 1 -

**CONFIDENTIAL**

CLASSIFICATION		CONFIDENTIAL		DISTRIBUTION							
STATE	<input checked="" type="checkbox"/>	NAVY	<input checked="" type="checkbox"/>	NSRB							
ARMY	<input checked="" type="checkbox"/>	AIR	<input checked="" type="checkbox"/>	FBI							

**CONFIDENTIAL**CONFIDENTIAL

50X1-HUM

## TABLE OF CONTENTS

	<u>Page</u>
Introduction	7
I. Electric Processes in Simple Linear Circuits	9
1. Linear Electric Circuits	9
a. Linear Elements of Electric Circuits	11
b. Description of Electric Processes in Linear Circuits	11
c. Method of Constructing Equivalent Circuits	16
2. Spectra of Electric Signals	16
a. Spectra of Periodic Signals	17
b. Spectra of Single Signals	19
3. Passage of Harmonic Signals Through Linear Circuits	19
a. Stationary Processes in Linear Circuits When Acted on by a Harmonic EMF	23
b. Nonstationary Processes in Linear Circuits When Acted on by a Harmonic Voltage	24
c. Frequency and Phase Characteristics of Circuits	28
d. Differentiating and Integrating Circuits	30
4. Electric Processes in Linear Circuits When Acted on by a Pulsed EMF	30
a. Passage of Single Square-Wave Pulses Through Simple Linear Circuits	34
b. Evaluation of Distortions of Pulse Form According to the Form of the Circuit Characteristics	37
c. Delay of Pulses in Passing Through Linear Circuits	39
5. Electric Processes in Oscillatory Circuits	39
a. Free Oscillations in a Single Circuit	41
b. Stationary Processes in a Single Oscillatory Circuit When Acted on by a Harmonic EMF	43
c. Electric Processes in an Oscillatory Circuit When Acted on by Single Square-Wave Pulses	47
d. Stationary Processes in Coupled Circuits When Acted on by a Harmonic EMF	50
e. Energy Transfer in Coupled Circuits	51
6. Electric Processes in Lines	51
a. Stationary Processes in Lines When Acted on by a Harmonic EMF	53
b. Reflection of Current and Voltage Waves From the End of a Line	55
c. The Input Impedance of Lines	58
d. Nonstationary Processes in Lines	61
e. Artificial Lines	

CONFIDENTIAL**CONFIDENTIAL**

**CONFIDENTIAL**  
CONFIDENTIAL

50X1-HUM

	<u>Page</u>
II. Electron Tubes	
1. Two-Electrode Electron Tubes	66
2. Three-Electrode Electron Tubes	68
a. Static Characteristics of Triodes	68
b. Triode Parameters	70
c. Dynamic Characteristics of Triodes	72
d. Use of Triodes for Amplification of Electric Signals	74
e. Use of Electron Tubes for Generation of Electric Signals	76
3. Input Admittance of the Three-Electrode Tube	77
4. Multigrid Electron Tubes	80
a. Characteristics and Parameters of Tetrodes	80
b. Pentodes and Beam Tetrodes	81
c. Electron Tubes With Two Control Grids	83
5. Methods of Analyzing Circuits Containing Electron Tubes	84
a. Use of Tube Characteristics	84
b. Construction of Circuits Equivalent to Those Containing Electron Tubes	87
6. Ionic Devices	89
a. Two-Electrode Ionic Devices	89
b. Ionic Devices With a Control Grid	92
III. Amplifiers of Electric Signals	
1. Basic Amplifier Circuits	95
a. Basic Amplifier Characteristics and Circuits	95
b. Types of Tube Operation in Amplifying Stages	100
2. Aperiodic Voltage Amplifiers	101
a. Characteristics of a Resistance-Coupled Amplifier Stage	101
b. Tubes for Resistance-Coupled Amplifier Stages	106
c. Calculation of a Resistance-Coupled Amplifier	108
d. Remarks on Transformer- and Choke-Coupled Amplifier Stages	112
3. Tuned Radio-Frequency Amplifiers	114
a. Tuned Radio-Frequency Amplifier Circuits	114
b. Tuned Stage With One Oscillatory Circuit	116
c. A Band-Pass Amplifier	119
4. Output Stages of Amplifiers in Class "A" Operation	120
a. An Output Stage With the Load Connected Directly in the Plate Circuit of the Tube	120
b. An Output Stage With Transformer Connection of the Load into the Plate Circuit of the Tube	123
c. Tubes for Output Stages of Amplifiers	127

- 3 -

CONFIDENTIAL  
**CONFIDENTIAL**

**CONFIDENTIAL**CONFIDENTIAL

50X1-HUM

	<u>Page</u>
5. Noise of Amplifiers	129
a. Circuit Noises	129
b. Tube Noises	132
c. Total Noise of the Output Stage of an Amplifier	134
6. Feedback in Amplifier Circuits	138
a. Amplification of Signals in Circuits Using Feedback	138
b. Characteristics of Amplifiers With Feedback	141
c. Stability of Circuits With Feedback	142
d. Parasitic Feedbacks in Amplifiers	144
IV. Some Special Amplifiers	
1. Amplification of Single Pulsed Signals	149
a. Distortion of Pulse Forms in Passing Through a Resistance-Coupled Amplifier Stage	149
b. Passage of Pulses Through a Multistage Resistance-Coupled Amplifier	156
c. Remarks on Proper Selection of Amplifier Passbands	160
2. Correction of Linear Distortion in Amplifier Circuits	162
a. Correction of Amplifier Characteristics at the High-Frequency End of the Spectrum	162
b. Correction of Amplifier Characteristics at the Low-Frequency End of the Spectrum	168
c. The Theory of Complex Correction Circuits	172
d. Use of Negative Feedback for Correction of Amplifier Characteristics	174
3. Cathode-Loaded Amplifier Stages	185
a. Circuit of a Cathode-Loaded Stage	185
b. Characteristics of Cathode-Loaded Stages	188
c. Some Applications of Cathode-Loaded Stages	191
4. Direct Current Amplifiers	195
a. Direct Current Amplifiers Supplied From Voltage Dividers	195
b. Direct Current Amplifiers With Potentiometer-Coupled Stages	202
c. Stability of Direct Current Amplifiers	205
d. Direct Current Amplifiers With a Carrier Frequency	207
V. Generators of Harmonic Oscillations	
1. Excitation of Harmonic Oscillations	211
a. Compensation of Damping of the Oscillatory Circuit	211
b. Limiting the Amplitude of Self-Excited Oscillations	214
2. Output Stages of Oscillators	216
a. Basic Characteristics of the Operation of Output Stages	216
b. Elements of the Calculation of Output Stages	221
c. Energy Transfer From the Oscillator to the Load	226

- 4 -

CONFIDENTIAL**CONFIDENTIAL**

**CONFIDENTIAL**CONFIDENTIAL

50X1-HUM

	<u>Page</u>
3. Master Oscillators	228
a. Master Oscillator Circuits	228
b. The Calculation of a Master Oscillator	230
c. The Coupling-Hysteresis Effect in a Self-Excited Oscillator	231
d. Some Methods for Stabilizing Master Oscillator Frequencies	234
4. Some Special Oscillators	236
a. Beat-Frequency Oscillators	236
b. RC-Oscillators Producing Harmonic Oscillations	240
c. Oscillators for High-Frequency Heating of Metal Objects	245
d. Supplying the Dees of a Cyclotron With a High-Frequency Voltage	247
VI. Relaxation Oscillators and Trigger Circuits	
1. Relaxation Oscillators	256
a. Basic Circuit of the Multivibrator	256
b. Voltage Form Excited by a Multivibrator	258
c. Calculation of a Multivibrator Circuit	266
d. Multivibrators for Excitation of Square-Wave Pulses	268
2. Trigger Circuits	272
a. Trigger Circuits With Two Stable States	272
b. Trigger Circuits With One Stable State	282
3. Counting Circuits	293
a. Binary Counting Circuits	293
b. Ring Counting Circuits	300
c. Decimal Counters	305
VII. Measurement of Low Currents. Vacuum-Tube Electrometers	
1. Electrometer Tubes	312
a. Electrometer Measurement of Low Currents	312
b. Use of Electron Tubes for Measurement of Low Currents	314
c. Parameters of Electrometer Tubes	317
d. Operation of Amplifying Tubes as Electrometers	322
2. Single-Stage Vacuum-Tube Electrometers	325
a. Simple Vacuum-Tube Electrometer Circuit	325
b. Bridge Circuits Using Two Tubes	328
c. Bridge Circuits Using One Tube	331
d. Measuring Low Current by the Charging of a Capacitance	341
3. Multistage Vacuum-Tube Electrometers	343
a. Vacuum-Tube Electrometers Using Bridge Circuits at the Input	343
b. Vacuum-Tube Electrometers With Negative Feedback	345
c. The Null Method of Comparing Two Low Currents	351
d. Vacuum-Tube Electrometers With Dynamic Capacitance	354

CONFIDENTIAL**CONFIDENTIAL**

**CONFIDENTIAL**CONFIDENTIAL

50X1-HUM

	<u>Page</u>
VIII. Recording of Electric Impulses Produced by Particle Counters	
1. Some Information on Particle Counters	358
a. Voltage Pulses Produced by Ionization Chambers	358
b. Voltage Pulses Produced by Proportional Counters	364
c. Some Characteristics of (Nonself-Quenching) Geiger-Muller Counters	367
d. Remarks on Crystal Counters and the Use of Electron Multipliers for Registration of Particles	372
2. Counting a Number of Pulses	375
a. Circuits for Controlling the Operation of Mechanical Recorders	375
b. Counting a Great Number of Pulses per Unit Time	379
3. Circuits Designed for Operation With Particle Counters	382
a. Measuring Circuits for Operation With Ionization Chambers	382
b. Construction of Circuits for Operation With Proportional Counters	396
c. Quenching Circuits for Geiger-Muller Counters	398
4. Analysis of Pulses According to Their Amplitude	408
a. Simple Amplitude Analyzers	408
b. Differential Amplitude Analyzers	413
5. Recording of Pulses Produced by Several Particle Counters	418
a. Recording of Coincidences	418
b. Recording of Anticoincidences	427
IX. Supply Circuits for Laboratory Equipment	
1. Rectifiers	433
a. Rectifier Circuits	433
b. Elements of the Calculation of Rectifier Circuits	440
c. Evaluation of the Parameters of Rectifier Filters	444
2. Simple Direct Current and Voltage Regulators	451
a. Characteristics of Simple Voltage and Current Regulators	451
b. Simple Direct Current Regulators	453
c. Simple Direct Current Voltage Regulators	456
3. Electronic Voltage Regulators	460
a. Electronic Regulators of the Parallel Type	460
b. Electronic Regulators of the Series Type	464
c. Cathode-Loaded Electronic Regulators	468
4. Direct Current Regulators	475
a. Regulators for a Low Direct Current	475
b. Regulators for a High Direct Current	478
	484

Bibliography

- E N D -

- 6 -

CONFIDENTIAL**CONFIDENTIAL**